



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

www.sathyabama.ac.in

SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

M. Arch (Sustainable Architecture)

PROFESSIONAL TRAINING (S89APT)

JUL 2022 - AUG 2022

Name of the Student : NAYONIKA CHAKRABORTY

Semester : III

Reg No. : 41890010

Batch : 2021-2023



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VIVA-VOCE EXAMINATION

This is to certify that the Professional Training Report (S89APT) is the work of NAYONIKA CHAKRABORTY who had undergone training Banka And Associates, Guwahati and has been monitored by the continuous assessment during Jul 2022 to Aug 2022.

Dr. Devyani Gangopadhyay
HOD AND DEAN

Submitted for Viva voce Examination held on 20/12/2022

Internal Examiner

External Examiner



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DECLARATION

I NAYONIKA CHAKRABORTY hereby declare that this Professional Training Report (11th July 2022 – 13th August 2022) done by me under the guidance of Ar. Santosh Banka is submitted in partial fulfillment of the requirements for the completion of practical training session.

DATE : 13th August 2022

PLACE : Guwahati

A handwritten signature in blue ink that reads 'Nayonika Chakraborty'.

SIGNATURE OF CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA INSTITUTE OF SCIENCE & TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay Dean, School of building and Environment** for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to **Ar. Santosh Banka** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my Training.

I would also like to express my sincere thanks to Ar. Catherine Selvaraj (Internal Co-ordinator) for her valuable guidance, during the entire Professional Training period.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Architecture who were helpful in many ways for the completion of the project.

(Also thank Architect of the firm) _ **Ar. Santosh Banka**

NH Centre Point Building, 3rd Floor, Bora Service,
GS Rd, Ulubari, Guwahati, Assam 781007

WORK DIARY

DAY	PROJECT NAME	WORK DONE	DAY	PROJECT NAME	WORK DONE
1	H.K. Sagar, Amingaon	Study	16	H.K. Sagar, Amingaon	Project Development
2	H.K. Sagar, Amingaon	Study	17	H.K. Sagar, Amingaon	Project Development
3	H.K. Sagar, Amingaon	Analysis	18	H.K. Sagar, Amingaon	Services
4	H.K. Sagar, Amingaon	Services	19	H.K. Sagar, Amingaon	Services
5	H.K. Sagar, Amingaon	Services	20	H.K. Sagar, Amingaon	Services
6	H.K. Sagar, Amingaon	Services	21	H.K. Sagar, Amingaon	Services
7	H.K. Sagar, Amingaon	Services	22	H.K. Sagar, Amingaon	Project Development
8	H.K. Sagar, Amingaon	Services	23	H.K. Sagar, Amingaon	Simulations
9	H.K. Sagar, Amingaon	Project Development	24	H.K. Sagar, Amingaon	Simulations
10	H.K. Sagar, Amingaon	Project Development	25	H.K. Sagar, Amingaon	Daylighting Analysis, ECBC
11	H.K. Sagar, Amingaon	Project Development	26	H.K. Sagar, Amingaon	Project Development
12	H.K. Sagar, Amingaon	Analysis	27	Teok Mandir	Planning
13	H.K. Sagar, Amingaon	Project Development	28	Teok Mandir	Planning
14	H.K. Sagar, Amingaon	Project Development	29	H.K. Sagar, Amingaon	Project Development
15	H.K. Sagar, Amingaon	Project Development	30	H.K. Sagar, Amingaon	Project Development

Chief Architect Signature: 

Office seal:





To Whom It May Concern

JOINING LETTER

This is to certify that Miss Nayonika Chakraborty, a student of Sathyabama Institute of Industrial Technology will be joining us as an Architect Trainee Assistant from 11th July 2022. She will be working with us for a period of 30 working days and she will be allowed to use the copies of drawing for purely academic purposes for her report.

For Banka & Associates



.....
COA Reg No. CA/99/24049



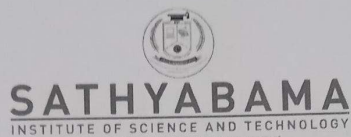
TO WHOM IT MAY CONCERN

This is to certify that Miss Nayonika Chakraborty, a student of Sathyabama Institute of Industrial Technology has completed her Professional Training at Banka and Associates as an Architect Trainee Assistant for a period of 30 working days and she will be allowed to use the copies of drawing for purely academic purposes for her report.

We wish her all the best for her future endeavours.



.....
COA Regn: CA/99/24049
For Banka & Associates



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SCHOOL OF BUILDING & ENVIRONMENT, DEPARTMENT OF ARCHITECTURE
M. Arch (Sustainable Architecture) Batch 2021-2023
Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 15 working days in the office to be submitted to HOD)

1. Name of the office / organization :	Banka and Associates
2. Address & Contact Number :	NH Center Point, 95 Road, Ulubassi
3. Name of the student :	Nayonika Chakraborty
4. Duration :	From 28/07/2022 To 13/08/2022
5. Total No. of days :	15
6. Evaluation of Performance criteria shall be on	

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month;

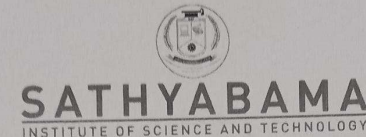
Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillsets related to project management		✓			
Design Management		✓			
Understanding the Triple Constraints		✓			
Observation during Site Visits		✓			
Understanding of construction details	✓				
Understanding of Construction sequences		✓			
Site Supervision / Discussion with clients	✓				
Adherence to Time schedule	✓				
Quantitative aptitude		✓			
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*	A
------------------	---

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Good.

8. Signature of the
Head of the Office /
Organization (With Seal)



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1. Name of the office / organization :	Banka and Associates
2. Address & Contact Number :	NH Center Point, 95 Road, Ulubassi
3. Name of the student :	Nayonika Chakraborty
4. Duration :	From 31/07/2022 To 27/08/2022
5. Total No. of days :	15
6. Evaluation of Performance criteria shall be on	

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month;

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillsets related to project management		✓			
Design Management		✓			
Understanding the Triple Constraints		✓			
Observation during Site Visits		✓			
Understanding of construction details	✓				
Understanding of Construction sequences		✓			
Site Supervision / Discussion with clients	✓				
Adherence to Time schedule	✓				
Quantitative aptitude		✓			
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*	A
------------------	---

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Good.

8. Signature of the
Head of the Office /
Organization (With Seal)



INTRODUCTION

The commercial complex is to be developed by M/s HK Sagar Realtors LLP. The project site is located at 5KM Stone, NH-31, Amingaon, Mouza: Sila Sinduri Ghopa, North Guwahati, Assam on a land measuring 15.54 Acres.

The project is being implemented by a partnership firm namely HK Sagar Industrial Park which was formed on 20.02.21. The partnership firm is proposed to be converted to Limited Liability Partnership and the same is under process.

M/s HK Sagar Realtors LLP has proposed the Commercial Complex Project which includes Five Blocks, i.e. Block A (LG, B+UG+ 8F), Block B (LG, B+UG+ 8F), Block C (LG, B+UG+ 8F), Block D (Toilet block) and Block E (Toilet Block).

The project facilities include:

1. Shops: Block A, B & C (GF to 4F)
2. Offices Block A, B & C (5F to 8F)
3. Podium and Basement Parking

S. No.	Particulars	Total Area (m ²)
1.	Total Plot Area	62,899.83
2.	Permissible Ground Coverage (@40 % of the plot area)	25,159.60
3.	Proposed Ground Coverage (@ 34.49 % of the plot area)	21,698.88
4.	Permissible FAR (@ 300 of the plot area)	1,88,698.58
5.	Proposed FAR (@300 of the plot area)	1,88,698.58
6.	Non -FAR	83,871.56
	• Basement area	42,004.40
	• Podium area	31,371.09
	• Services area(Lift, Staircase and Lobby)	10,496.07
7.	Total Built Up Area	2,72,570.14
8.	Green Area Proposed (@20 % plot area)	12,579.96
9.	Maximum Height of the Building up to terrace level (meter)	40.5

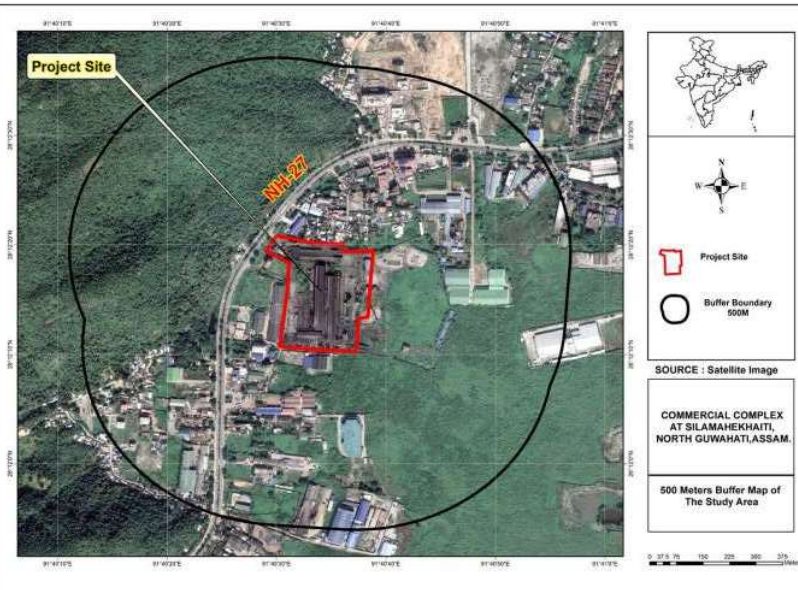
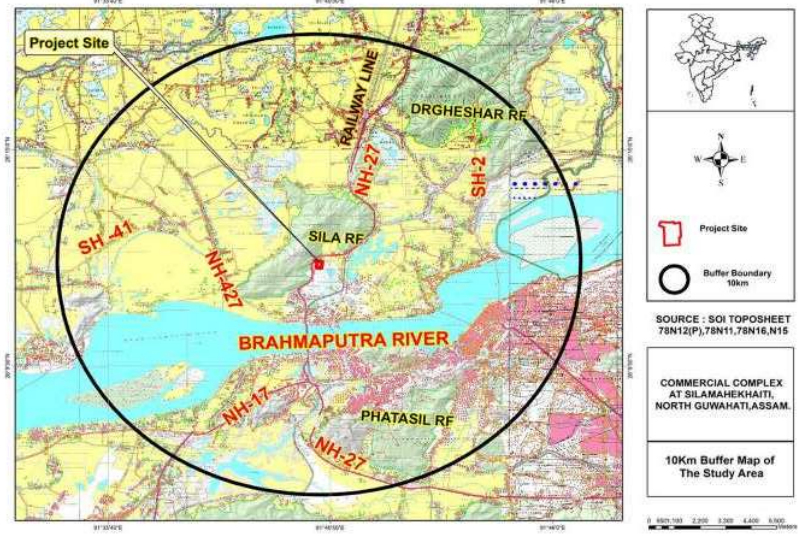
Detailed Area Statement

S. No.	Particulars	Total Area (m ²)
1.	Proposed FAR	1,88,698.58
2.	Non -FAR	83,871.56
	• Basement area	42,004.40
	• Podium area	31,371.09
	• Services area	10,496.07
	TOTAL BUILT-UP AREA	2,72,570.14

Built-up area break-up

PROJECT COST

The Total Cost (Land Cost + Development Cost) of the proposed project will be INR 668 Crores.



SITE LOCATION

The project site is located at 5KM Stone, NH-31, Amingaon, Mouza: Sila Sinduri Ghopa, North Guwahati, Assam The geographical co-ordinates of project site are 26°12'20.5"N and 91°40'29.8"E.

CONNECTIVITY

The Nearest Highway is NH-27 which is adjacent to site towards W direction, SH-2 is 2.2 km towards S direction, NH-427 is 2.3 km towards SSW direction, NH-17 is 5.1 km towards S direction and SH-41 is 5.3 km towards NW direction of the project site. The nearest Railway Station being Agthori Railway Station is about 1.0 km towards SE from the project site. Guwahati Airport is at 11.5 km from project site.



WATER REQUIREMENT AND SUPPLY SYSTEM

During operation phase, the source of water supply will be GMDWSB (Guwahati Metropolitan Drinking Water and Sewage Board). The total water requirement for the project will be approx. 1320 KLD out of which domestic water demand is 694 KLD. The fresh water requirement will be 317 KLD. However, one time fresh water demand for the project will be 1320 KLD. The calculation of daily water requirement and waste water is given below in Table 3 & 4 respectively.

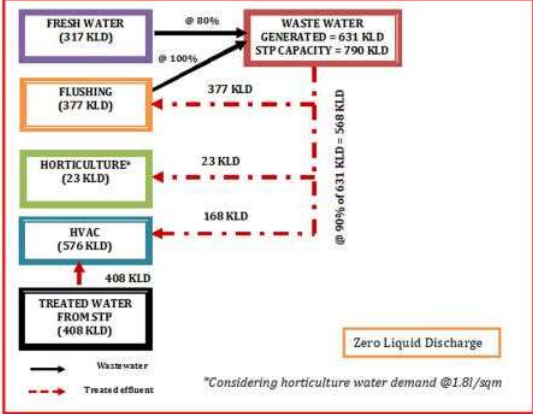
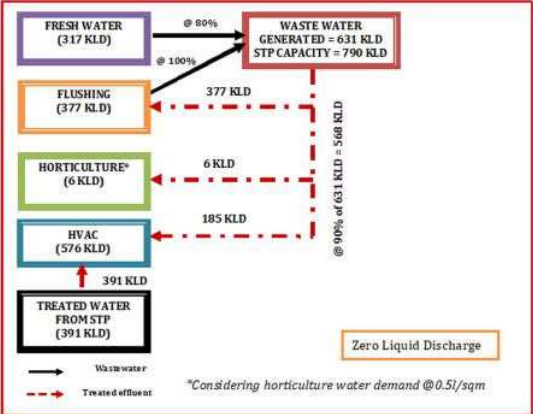
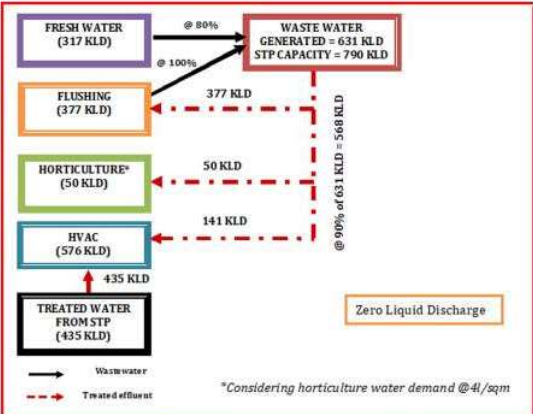
S. No.	Description	Occupancy	Rate of water demand (lpcd)		Total Water Requirement		
A.	Domestic Water						
			Fresh	Flushing	Fresh	Flushing	Total
	Block A						
1.	Ground Floor (Shops)						
	• Staff	116	@25 lpcd	@20 lpcd	3	2	5
	• Visitors	2,200	@ 5 lpcd	@10 lpcd	11	22	33
2.	First Floor to Fourth Floor (Shops)						
	• Staff	239	@25 lpcd	@20 lpcd	6	5	11
	• Visitors	4,550	@ 5 lpcd	@10 lpcd	23	45	68
3.	Fifth Floor to Eighth Floor (Office)						
	• Staff	2,508	@25 lpcd	@20 lpcd	63	50	113
	• Visitors	279	@ 5 lpcd	@10 lpcd	1	3	4
	Block B						
4.	Ground Floor (Shops)						
	• Staff	116	@25 lpcd	@20 lpcd	3	2	5
	• Visitors	2,200	@ 5 lpcd	@10 lpcd	11	22	33
5.	First Floor to Fourth Floor (Shops)						
	• Staff	239	@25 lpcd	@20 lpcd	6	5	11
	• Visitors	4,550	@ 5 lpcd	@10 lpcd	23	45	68
6.	Fifth Floor to Eighth Floor (Office)						
	• Staff	2,508	@25 lpcd	@20 lpcd	63	50	113
	• Visitors	279	@ 5 lpcd	@10 lpcd	1	3	4
	Block C						
7.	Ground Floor (Shops)						
	• Staff	108	@25 lpcd	@20 lpcd	3	2	5
	• Visitors	2,049	@ 5 lpcd	@10 lpcd	10	20	30
8.	First Floor to Fourth Floor (Shops)						
	• Staff	230	@25 lpcd	@20 lpcd	6	5	11
	• Visitors	4,362	@ 5 lpcd	@10 lpcd	22	44	66
9.	Fifth Floor to Eighth Floor (Office)						
	• Staff	2,452	@25 lpcd	@20 lpcd	61	49	110
	• Visitors	272	@ 5 lpcd	@10 lpcd	1	3	4
					317 KLD	377 KLD	694 KLD
Total Domestic Water = 694 KLD							
B.	Horticulture	12,579.96 m ²	4 lt./sqm		50 KLD		
C.	HVAC (12x400)	12 Hours	@ 10Litre/ Hours		576 KLD		
Grand Total water demand = 1320 KLD							

WASTE WATER CALCULATION

Domestic Water	694 KLD
• Fresh water	317 KLD
• Flushing water	377 KLD
Waste water [@80% fresh + 100% flushing]	254+377= 631 KLD
STP Capacity (at 1.25 times of W.W generated)	790 KLD

TOTAL PARKING CALCULATION

Parking Required: (As per Assam State Bye laws)
For Shops:
Parking slots for self = 1,14,604.06/75 = 1528 Nos. of CAR
Parking slots for visitor = 1,14,604.06/150 = 764 Nos. of CAR
For Office:
Parking slots for self = 90,649.76/100 = 906 Nos. of CAR
Parking slots for visitor = 90,649.76/150 = 604 Nos. of CAR
Total Parking Required = 1528 + 764 + 906 + 604 = 3802 Nos.
Parking Proposed:
Open parking = 781 Nos.
Ground floor parking = 1,266 Nos.
Basement parking (Multi level) = 1,760 Nos.
Total = 3,807 Nos



: Water Balance Diagram (Summer, Monsoon and Winter Season)

589APT - PRACTICAL TRAINING

- The storm water collection system for the premises shall be self-sufficient to avoid any collection/stagnation and flooding of water.
- The drains shall be located near the carriage way along either side of the roads.
- Taking the advantage of road camber, the rainfall run off from roads shall flow towards the drains.
- Storm water from various plots/shall be connected to adjacent drain by a pipe through catch basins.
- Therefore, it has been calculated to provide 10 rainwater harvesting pits at selected locations, which will catch the maximum run-off from the site.

CALCULATIONS FOR STORM WATER LOAD

$$\begin{aligned} \text{Plot Area} &= 62,899.83 \text{ m}^2 \\ \text{Roof-top area} &= \text{Ground Coverage} = 21,698.88 \text{ m}^2 \\ \text{Green Area} &= 12,579.96 \text{ m}^2 \\ \text{Paved Area} &= \text{Plot Area} - (\text{Roof-top Area} + \text{Green Area}) \\ &= 62,899.83 - (21,698.88 + 12,579.96) \\ &= 62,899.83 - 34,278.84 \\ &= 28,620.99 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Roof-top area} &= 21,698.88 \times 0.05 \times 0.90 \\ &= 976.44 \text{ m}^3/\text{hr} \\ \text{Green Area} &= 12,579.96 \times 0.05 \times 0.30 \\ &= 188.69 \text{ m}^3/\text{hr} \\ \text{Paved Area} &= 28,620.99 \times 0.05 \times 0.80 \\ &= 1,144.83 \text{ m}^3/\text{hr} \\ \text{Total Runoff Load} &= 976.44 + 188.69 + 1,144.83 \\ &= 2,309.96 \text{ m}^3/\text{hr} \end{aligned}$$

$$\text{Taking 15 minutes retention time, volume of storm water} = \frac{2,309.96}{4} = 577.49 \text{ m}^3$$

$$\begin{aligned} \text{Capacity of Recharge pit} &= \pi r^2 h = 3.14 \times 2 \times 2 \times 5 = 62.8 \text{ m}^3 \\ \text{Hence No. of pits required} &= 577.49 / 62.8 = 9.19 \text{ pits say 10 pits} \\ \text{Total 10 Rain Water Harvesting pits are proposed for artificial ground water recharge.} \end{aligned}$$

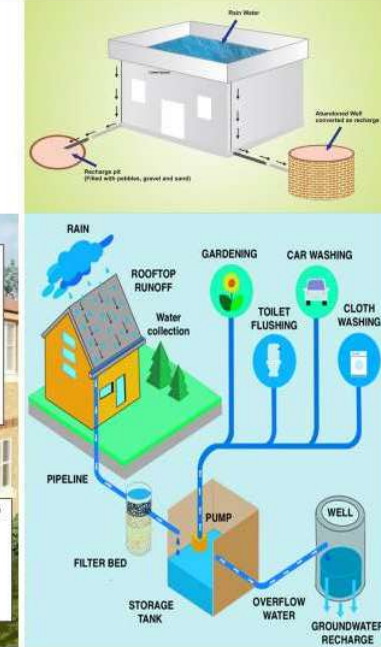
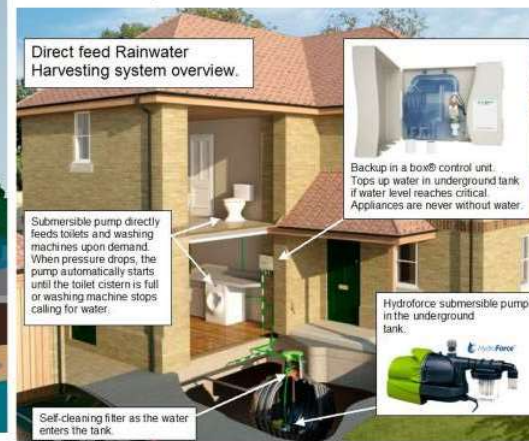


STORMWATER MANAGEMENT



Components of the roof top rainwater harvesting system.

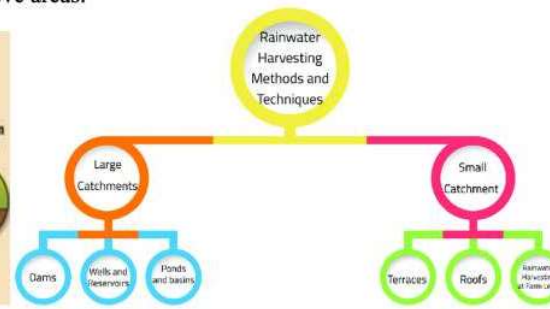
- 1- Catchment area
- 2- Transportation
- 3- First flush
- 4- Storage system
- 5- Delivery system
- 6- Filtration system



How is the storm water from within the site managed?

Most of the storm water produced on site will be harvested for ground water recharge. Thus proper management of this resource is a must to ensure that it is free of contamination. A detailed Storm Water Management Plan will be developed which will consider the sources of storm water. The plan will incorporate best management practices which will include the following:

- Regular inspection and cleaning of storm drains.
- Installation of clarifiers or Oil/Water separators system of adequate capacity around parking areas and garages as per requirement.
- Cover waste storage areas.
- Avoid application of pesticides and herbicides before wet season.
- Conducting routine inspections to ensure cleanliness.
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Good housekeeping in the above areas.



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Chennai, Tamil Nadu - 600119

NAME - **Nayonika Chakraborty**
REGN NO - **41890010**
ROLL NO - **21S895008**

TOPIC : **WATER MANAGEMENT**

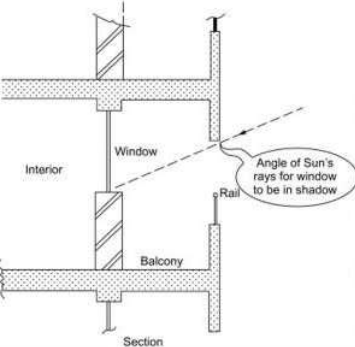
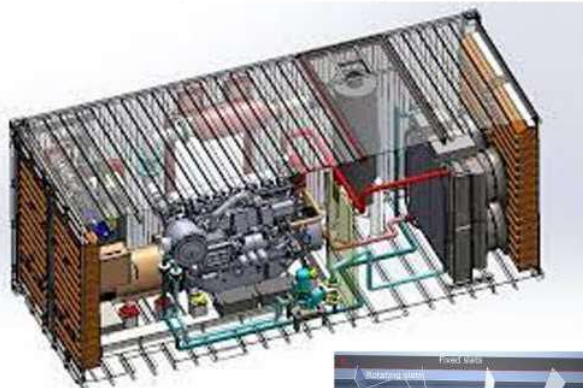
SHEET NO
3

D.G SET DETAILS

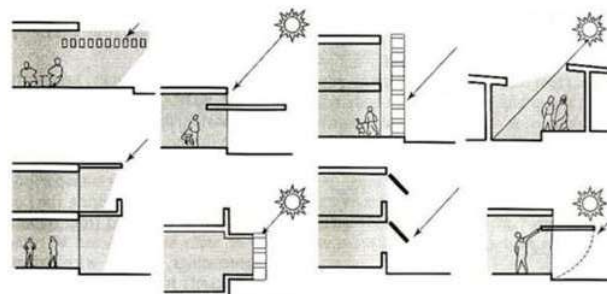
There is provision of 8 no. of DG sets of total capacity 15,520 kVA (2x1010 and 6x2250 kVA) for power back up in the Commercial Complex.

The DG sets will be equipped with acoustic enclosure to minimize noise generation and adequate stack height for proper dispersion as per CPCB norms. Effective measures have been incorporated to minimize the energy consumption in following manners:

- Followed Provisions of ECBC-2017 for Super ECBC Buildings
- Efficient Transformers.
- Power Factor 0.99
- Energy Efficient Motors (IE-3/IE-4)
- Air-Conditioning with Conventional air cooled chillers, Efficiency as per ECBC-2017,
- Efficient Chillers with VFDs in Pumps, AHUs and cooling Towers.
- Heat Recovery Units for fresh air intake.
- All Lighting fixtures - high efficacy LED
- All external Lighting fixtures - high efficacy LED
- Lighting Control with sensors.
- Building Management System to control HVAC and other electro-mechanical systems to minimize power consumption.



LOW-E COATING PERFORMANCE

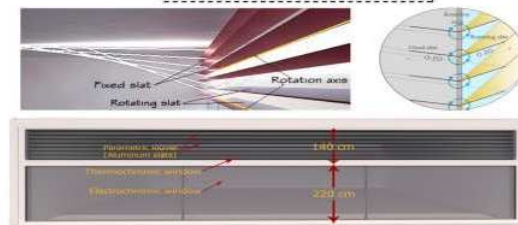
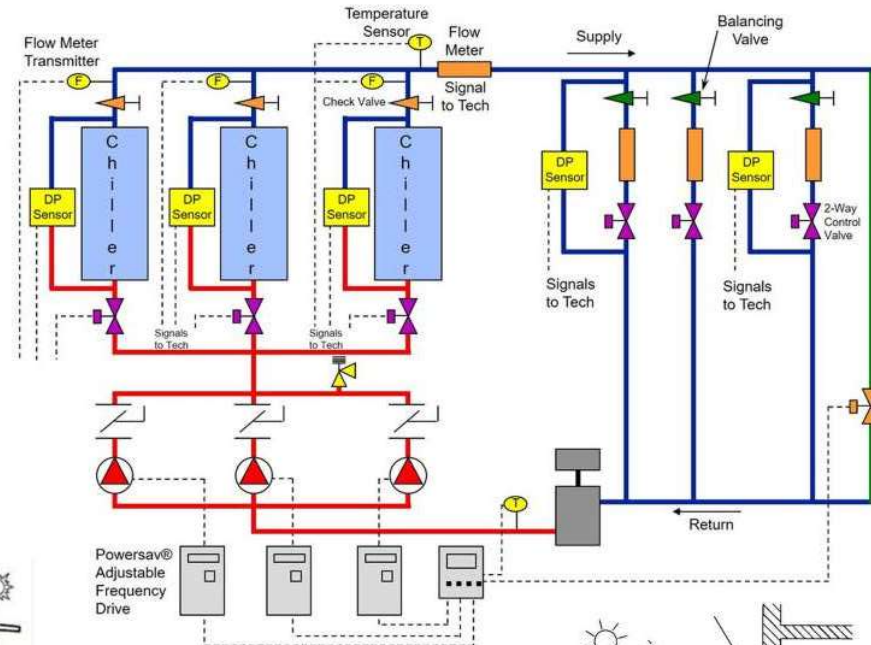


The design of shading devices will include simple fixed overhangs which are very effective at shading south-facing windows in the summer when sun angles are high.

The other shading devices which will be explored are as given below:

- 1) **Movable opaque:** Roller blind curtains, awnings etc. reduce solar gains but impede air movement and cut the view.
- 2) **Louvers:** They are adjustable or can be fixed.

Maintenance of air flow through the building is of great importance during the cooler hours of the day in non air-conditioned buildings. There will be a need for admitting controlled levels of diffused daylight. In most cases there will be a requirement for views out of the window.



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Chennai, Tamil Nadu - 600119

NAME - **Nayonika Chakraborty**
REGN NO - **41890010**
ROLL NO - **21S895008**

TOPIC : **LOUVERS, GLASS, CHILLER
PLANT DETAILS**

SHEET NO
4

MBBR TECHNOLOGY

An external sewage network shall collect the sewage from all units, and flow by gravity to the sewage treatment plant.

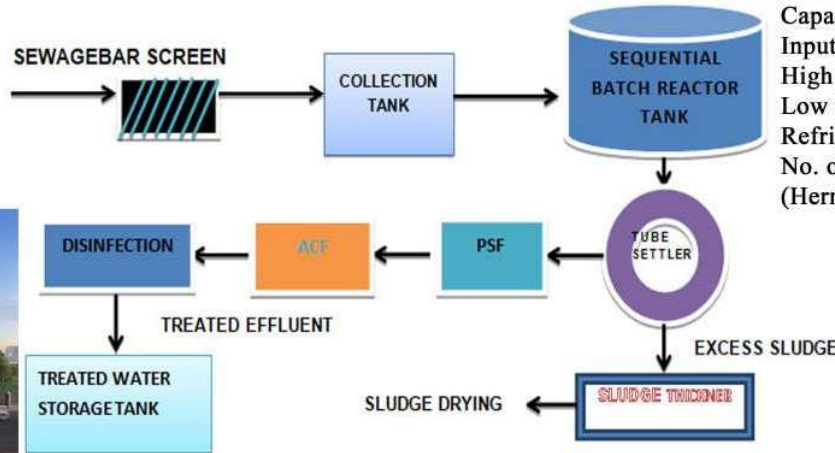
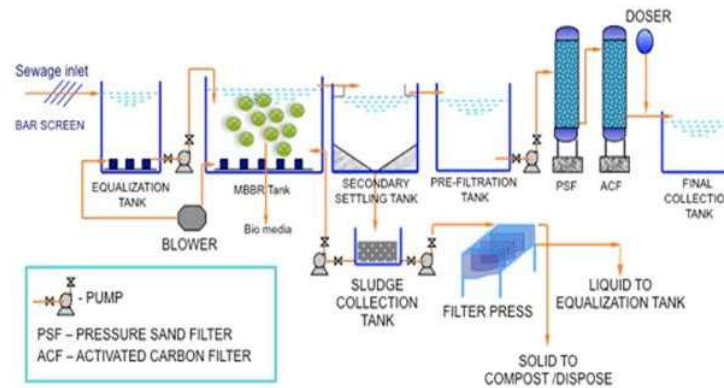
Following are the benefits of providing the Sewage Treatment Plant in the present circumstances:

- The process has long retention time and can absorb shock load situation.
- Reduced net daily water requirements, source for Flushing and Horticultural purposes by utilization of the treated waste water.
- Reduced dependence on the public utilities for water supply and sewerage systems.
- The process produces a well-oxidized sludge in small quantities only, which can be removed and used as manure.

a. Wastewater Details

- (a) Daily load : 631 KLD
 (b) Duration of flow to STP : 24 hours
 (c) Temperature : Maximum 32oC
 (d) pH : 6.5-8.5
 (e) Colour : Mild
 (f) T.S.S. (mg/l) : 250-400 mg/l
 (g) BOD5 (mg/l) : 300-400 mg/l
 (h) COD (mg/l) : 600-700 mg/l
- b. Treated effluent
- (a) pH : 6.0 to 8.5
 (b) B.O.D. : <20 mg/l
 (c) C.O.D. : <100 mg/l
 (d) Total Suspended Solids : <20mg/l

STP MBBR technology is the use of a moving bed biofilm reactor in sewage treatment plants. MBBR wastewater treatment system enables efficient results of the disposal using low energy. The technology is used to separate organic substances, nitrification and denitrification.



Specifications of a VRF Outdoor Unit

Power Supply - 380-415V, 50 Hz
 Capacity - 115000 Btu/hr. (9.6 TR)
 Input Power - 8.93 kW (12 HP)
 High pressure side - 40 bar (4 MPa)
 Low pressure side - 33 bar (3.3 MPa)
 Refrigerant - R410A
 No. of compressors in each unit - 2 (Hermetically sealed scroll type)

Air conditioning is responsible for a large part of a building's energy consumption. A system was required that can take advantage of this variable occupancy schedule in its controlling its operational energy consumption. Further, decisions about use of some spaces and their air-conditioning requirements were not finalised at the beginning, requiring modularity and possibility of capacity expansion as features of system selection. Availability of water was also one constraint while selecting HVAC system. Keeping in mind all of the above factors, VRF system was proposed for the building

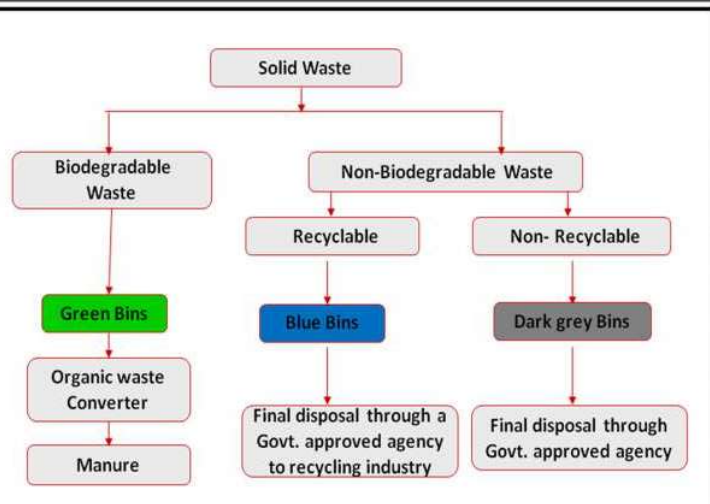


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TOPIC : **MBBR TECHNOLOGY , VRF UNIT**

SHEET NO
5

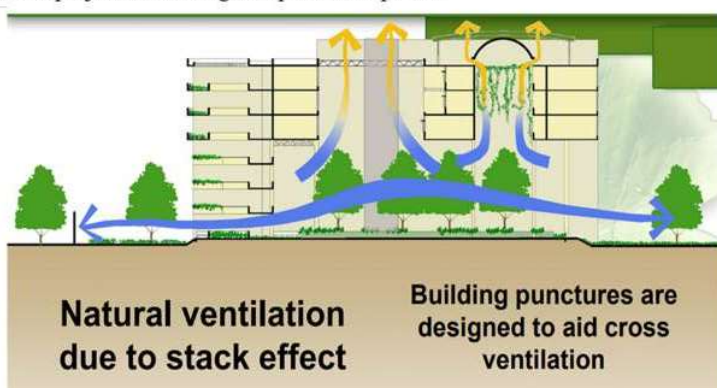
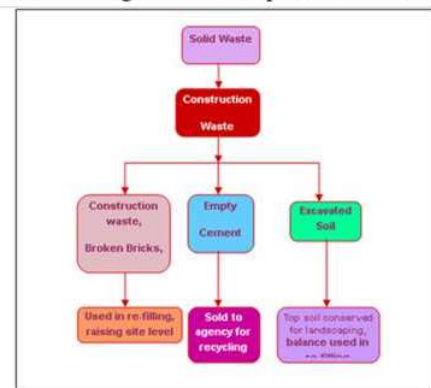


Collection and Transportation

- During the collection stage, the solid waste of the project will be segregated into biodegradable waste and non-biodegradable. Biodegradable waste and non biodegradable waste will be collected in separate bins. Proper guidelines for segregation, collection and storage will be prepared as per MSW Rules, 2016.
- To minimize littering and odour, waste will be stored in well-designed containers/ bins that will be located at strategic locations to minimize disturbance in traffic flow
- Care would be taken such that the collection vehicles are well maintained and generate minimum noise and emissions. During transportation of the waste, it will be covered to avoid littering.

Disposal

With regards to the disposal/treatment of waste, the management will take the services of the authorized agency for waste management and disposal of the same on the project site during its operational phase.

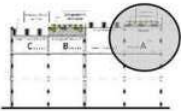
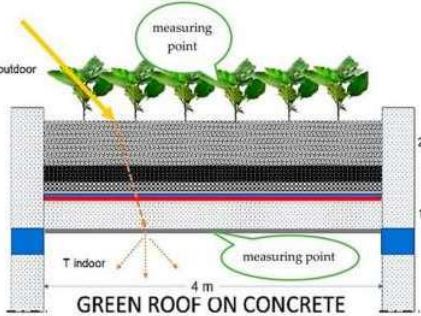


S. No.	Description	Occupancy	Waste Generated (kg/capita/day)	Waste Generated (kg/day)
A. Domestic Solid Waste				
Block A				
1.	Ground Floor (Shops)			
	• Staff	116	0.25	29
	• Visitors	2,200	0.15	330
2.	First Floor to Fourth Floor (Shops)			
	• Staff	239	0.25	60
	• Visitors	4,550	0.15	682
3.	Fifth Floor to Eighth Floor (Office)			
	• Staff	2,508	0.25	627
	• Visitors	279	0.15	42
Block B				
4.	Ground Floor (Shops)			
	• Staff	116	0.25	29
	• Visitors	2,200	0.15	330
5.	First Floor to Fourth Floor (Shops)			
	• Staff	239	0.25	60
	• Visitors	4,550	0.15	682
6.	Fifth Floor to Eighth Floor (Office)			
	• Staff	2,508	0.25	627
	• Visitors	279	0.15	42
Block C				
7.	Ground Floor (Shops)			
	• Staff	108	0.25	27
	• Visitors	2,049	0.15	307
8.	First Floor to Fourth Floor (Shops)			
	• Staff	230	0.25	57
	• Visitors	4,362	0.15	654
9.	Fifth Floor to Eighth Floor (Office)			
	• Staff	2,452	0.25	613
	• Visitors	272	0.15	41
B.	Horticultural Waste (3.10 acres)		@ 0.2 kg/acre/day	0.62
C.	STP Sludge		Wastewater generated x 0.35 x B.O.D difference/1000	86
Total Solid Waste Generation = 5,325.62 kg/day say 5,326 kg/day				

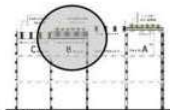
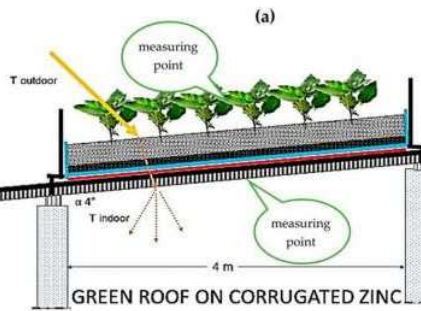


GREEN ROOF

Green Roof represents a natural form of vegetation that is largely self-sustaining and evolving. Certainly, it is the most cost effective and most natural infrastructure to reduce stormwater run-off from buildings at the source. Although, extensive Green Roofs only partially restore the environmental footprint of a structure, it is proven to be the most efficient and most natural.

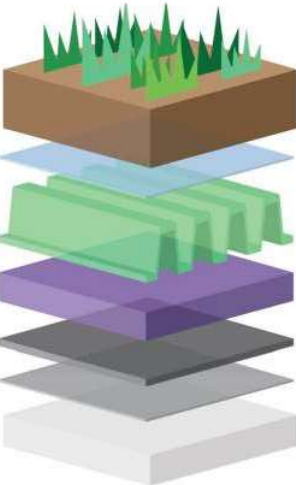


Green roofs are largely associated with urban sites as a means to provide habitats for insects, birds and other small animals to improve biodiversity.



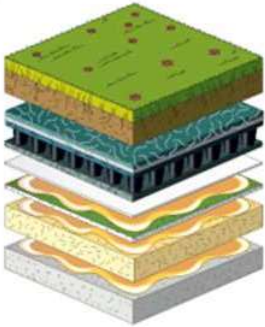
BENEFITS

- Run-off attenuation reduces sewer overflows
- Creates a beneficial monoclimate by cooling and humidifying the surrounding air.
- Absorbs greenhouse gases, air pollution and dust.
- Reduces the heat island effect, which is the main cause of ozone production
- Protects the roof from mechanical damage and UV rays
- Can provide extra insulation
- Reduces noise levels
- Many of the materials used in green roof construction are manufactured from recycled building materials, plastics and rubber reducing landfill disposal.

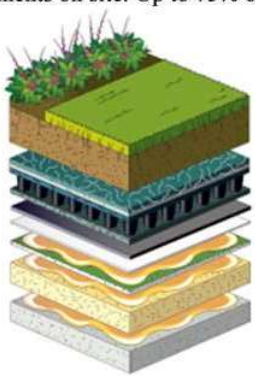


- Vegetation
- Growing Substrate
- Filter Sheet
- Drainage Layer
- Protection Mat
- Root Barrier
- Waterproofing
- Roof Deck

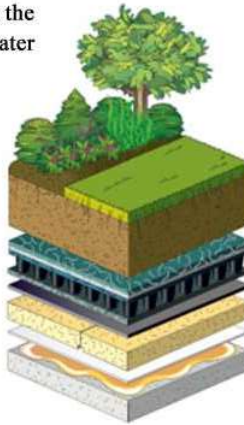
Green roofs retain water and lower run off which in turn will reduce the drainage and water storage requirements on site. Up to 75% of rainwater can be absorbed in green roofs.



Ultra-Extensive
2.5" - 4" Media Depth



Extensive
5" - 8" Media Depth



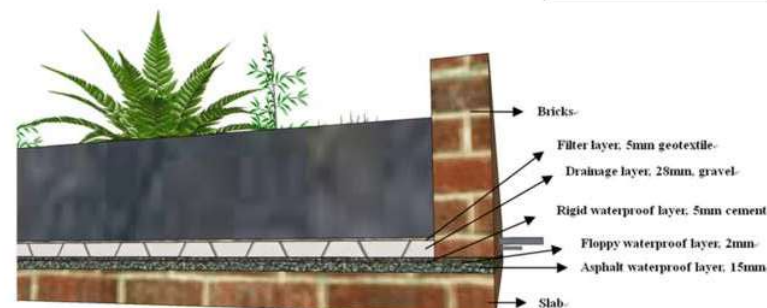
Intensive
8"+ Media Depth

Green Roof Type	EXTENSIVE	SEMI-INTENSIVE	INTENSIVE
Purpose	Stormwater Mitigation	Stormwater Mitigation, Biodiversity	Stormwater Mitigation, Biodiversity, Amenity Space
Vegetation	Moss-Herbs-Grasses	Grass-Herbs-Shrubs	Lawn/Perennials, Shrubs, Trees
Overall Depth	100-200mm 4 to 7 inches	150-250mm 6 to 10 inches	200-750mm + 8 to 30 inches +
Weight Range	100-200 kg/m ² 20-40 Lb/sf	120-300 kg/m ² 25-60 Lb/sf	220-800 kg/m ² + 45-160 Lb/sf +
Ecological Compensation	1 plant	2 plants	3 plants
Max. Rain Event	50-100mm 2"-4"	75-110mm 3"-4.2"	over 120mm over 4.2"
Irrigation System	not recommended	partially	required
Solar Garden Roof	yes, optional with high ROI	requires custom tailoring	only as pergola in amenity space
Blue Green Roof	optional	optional	standard with Green Roof Technology

according to El I



LNS (Local natural soil)



A photograph of a green roof covered in dense, low-growing vegetation, with a blue metal roof visible in the background.



AROMATIC HERBS: *Thymus vulgaris*

ADVANTAGES OF GREEN ROOF

- Green roofs create natural habitat, it can attract beneficial insects, birds, bees and butterflies.
- They can also filter pollutants and heavy metals out of rainwater.
- Green roofs decrease the total amount of runoff up to 50-85% and slow the rate of runoff from the roof
- Green roofs improve and reduce energy consumption. A green roof reduces cooling (by evaporative cooling) loads on a building by 50-90%.
- Help to insulate a building for sound; the soil helps to block lower frequencies and the plants block higher
- Green roofing can extend the lifespan of a roof by over 200% by covering the waterproofing membrane with growing medium and vegetation, this shields the membrane from ultra-violet radiation and physical damage

DISADVANTAGES OF GREEN ROOF

- The initial cost of installing a green roof can be double that of a normal roof.
- Depending on what kind of green roof it is, the maintenance costs could be higher.
- The wildlife green roofs attract may include pest insects which could easily infiltrate a residential building through open windows.
- The additional mass of the soil substrate and retained water places a large strain on the structural support of a building.
- Some existing buildings cannot be retrofitted with certain kinds of green roof because of the weight load of the substrate and vegetation exceeds permitted static loading.



METHOD OF INSTALLATION OF GREEN ROOF

1. Roll out the Root Barrier and/or protection fabric over the waterproofing membrane (consult the waterproofing manufacturer's recommendations). Overlap the sheets by a minimum of 2 inches.

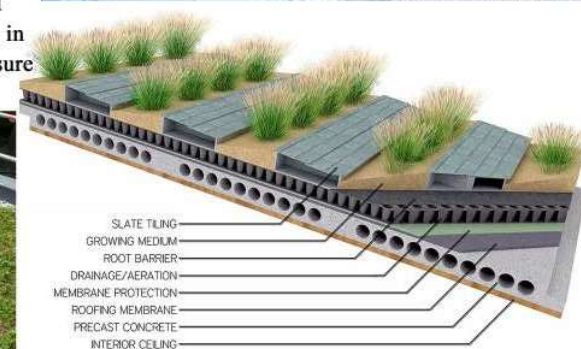


2. Take 2 empty trays and place them at one corner of the roof. The order should always be from left to right. Measure the width of the vegetation-free zone and draw a straight chalk line to mark the edges from which you will begin installing the trays. The lines have to form a perfect 90 degree angle.

3. Cut the tray with a circular saw/knife or reciprocating saw. Position the tray with the remaining edges facing outward. Cut the soil and plants with a knife and replace them in the tray. When all the trays are installed, fill the space around the perimeter with gravel ballast. Use the wheel barrow to move the gravel around the roof, and use the shovel to spread it.

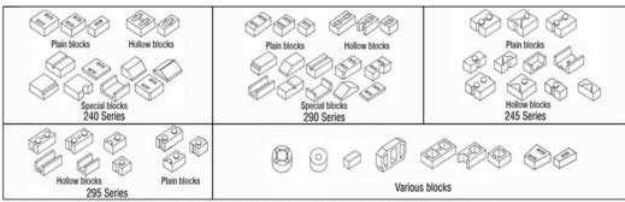


4. Position hoses and overhead sprinklers so that they provide optimum coverage of the vegetated area. Check the reservoirs in different places to make sure they are full of water.

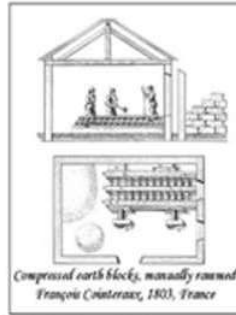


1. The substrate is protected from standing water: The substrate layer is about 3 inches thick and is protected from standing water through a drainage layer. The filter layer at the bottom of the substrate prevents the soil media from leaching outside the tray while enabling high water retention in a low weight system
2. Excess water is discharged efficiently: Each green roof tray has 47 drainage holes per square foot to enable efficient evacuation of excess water.
3. Efficient use of rain water: The tray has a permanent reservoir located at the bottom of the tray to regulate rainwater on the roof. Excess rainwater is collected within a 1.2 inch water reserve that stores 0.8 liters of water per square foot, and can be absorbed over time by the vegetation through a wicking process known as capillary irrigation.
4. Water and nutrient resources are shared between trays: Water is evenly distributed over the entire roof with an efficient and patented interconnecting system that enables water and nutrients to be shared between green roof trays





Compressed stabilised earth blocks by the Auram press 3000



Initial embodied energy (MJ/m ³ of materials)	Carbon emission (Kg of CO ₂ /m ³ of materials)
CSEB are consuming 11 times less energy than country fired bricks: CSEB produced on site with 5 % cement = 548.32 MJ/m ³ Country fired bricks = 6,122.54 MJ/m ³	CSEB are polluting 13 times less than country fired bricks: CSEB produced on site with 5 % cement = 49.37 Kg of CO ₂ /m ³ Country fired bricks = 642.87 Kg of CO ₂ /m ³

PROPERTIES	SYMBOL	UNIT	CLASS A	CLASS B	CLASS C
Dry compressive crushing strength (@ 28 days, +10% after 1 year)	σ_{cd}	MPa	5 - 7	4 - 5	3 - 4
Wet compressive crushing strength (@ 28 days, after 24 hours immersion)	σ_{cw}	MPa	3 - 4	2 - 3	1.5 - 2
Tensile crushing strength, dry (on a core @ 28 days)	τ	MPa	0.5 - 1	0.5 - 1	0.5 - 1
Bending crushing strength, dry (@ 28 days)	σ_{bs}	MPa	0.5 - 1	0.4 - 0.8	0.3 - 0.6
Shear crushing strength, dry (@ 28 days)	τ	MPa	0.4 - 0.6	0.3 - 0.5	0.2 - 0.3
Total water absorption	-	% weight	8 - 10	10 - 12	12 - 15
Apparent bulk density	γ	Kg/m ³	1900 - 2000	1800 - 1900	1700 - 1800
Poisson's ratio	μ	-	0.15 - 0.35		
Young's Modulus	E	MPa	700 - 1000		
Coefficient of thermal expansion	-	mm/m°C	0.010 - 0.015		
Swell after saturation (24 hours immersion)	-	mm/m	0.5 - 1		
Shrinkage (due to natural air drying)	-	mm/m	0.2 - 1		
Permeability		mm/sec	1.10 ⁻⁸		
Specific heat	C	KJ/Kg	0.65 - 0.85		
Coefficient of conductivity	λ	W/m°C	0.81 - 0.93		
Damping coefficient	m	%	5 - 10		
Lag time (for 40 cm thick wall)	d	h	10 - 12		
Coefficient of acoustic attenuation (for 40 cm thick wall at 500 Hz)	-	dB	50		
Fire resistance *	-	-	Good		
Flammability *	-	-	Poor		
Embodied energy (for 5% cement stabilised and produced by hand press)	-	MJ/m ³	572.58 **		
Carbon emission (CO ₂ /m ³ raw material)	-	CO ₂ /m ³	49.37 **		

Compressed Stabilized Earth Blocks (CSEB), commonly called, **Pressed Earth Blocks**, are construction material made using damp soil under high amount of pressure to form blocks. They are composed of dry inorganic subsoil, non-expansive clay, aggregates and Portland cement. CSEBs are an environmentally friendly alternative to clay bricks that most of the residential construction in India today uses.

Six production stages

There are 6 stages for the production of CSEB.

The following details are given for an Auram Press 3000 which can produces 1000 blocks 240 per day:

Preparation (Digging + Sieving)	2 to 4 people
Measuring	1 people
Mixing (dry + wet)	2 people
Pressing	3 people
Initial curing and first stacking	1 people
Final curing and stacking	2 people
Total No.	11 to 13 people

Notes for the production stages:

The number of persons for digging & sieving will vary with the type of soil.

The number of persons for the final curing & stacking will depend of the transportation distance.

Key words for the organisation of the blockyard

- Reduce the distance of transportation.
- Optimise the ratio output / number of workers, to get the best efficiency.
- Organize the block-yard as close as possible from the site.
- Organise the storeroom as close as possible from the blockyard.
- Organise the final stacking area as close as possible from the blockyard.
- It is preferable to have a linear organization but a circular one can also be suitable.



1 m² fired brick wall



1 m² Interlocking brick CSEB wall

Material	Quantity	Rate	Cost
140 Bricks 22x11x5.5		17 rs	2380 rs
2.17 Hours		125 rs	271 rs
28 kg		18 rs	504 rs
2 cubic feet sand		107 rs	214 rs
Total Cost			3369 rs/m²

Material	Quantity	Rate	Cost
32 pcs		55 rs	1760 rs
1.5 hours		125 rs	188 rs
8 kg		18 rs	144 rs
1 cubic feet sand		107 rs	107 rs
Total Cost			2199 rs/m²

SUITABILITY

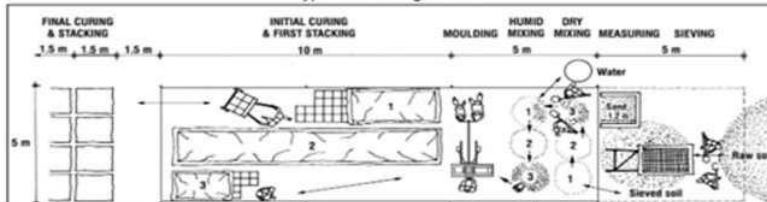
These blocks can be used in all climates, from temperate to very hot, tropical and mountains climates and can be used in Pan world in all continents.

- Depending upon the design mix, geo-climatic conditions, the blocks can be used for load bearing application for upto 4 floors.
- Not all type of soil can be used for CSEB. It is required to conduct testing of soil before manufacturing Bricks/Blocks.

INITIAL EMBODIED ENERGY PER M ³	CARBON EMISSIONS (Kg of CO ₂) PER M ³
CSEB = 572.6 MJ / m ³	CSEB = 51.5 Kg / m ³
Country Fired Brick (CFB) = 6,122.5 MJ / m ³	Country Fired Brick (CFB) = 642.9 Kg / m ³



Typical linear organization



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TOPIC : CSEB BLOCK

SHEET NO
10

MAXIMUM AND MINIMUM EFFECTIVE TEMPERATURE

MONTHS	MAXIMUM TEMPERATURE	MINIMUM HUMIDITY	MAXIMUM ET	MINIMUM TEMPERATURE	MAXIMUM HUMIDITY	MINIMUM ET
JANUARY	22.9	55.2	20.9	12.3	97.9	11.9
FEBRUARY	25.8	43.7	21.8	14.5	96.6	14.1
MARCH	29.6	43.3	24.7	18.2	97.0	17.9
APRIL	29.7	50.7	25.6	20.9	99.1	20.6
MAY	29.9	59.5	26.3	22.9	99.7	22.8
JUNE	30.4	56.7	26.4	24.9	99.0	24.5
JULY	30.5	64.2	27.2	25.4	98.5	25.0
AUGUST	30.8	60.2	26.9	25.3	98.9	25.1
SEPTEMBER	30.3	62.5	26.5	24.4	98.7	24.3
OCTOBER	28.9	58.1	25.3	21.8	98.6	21.1
NOVEMBER	26.6	55.0	23.5	17.5	98.2	17.1
DECEMBER	23.9	23.9	20.3	13.8	97.3	13.4

MONTHS	HEATING TIME (AM)	COOLING TIME (PM)
JANUARY	1:30 PM	3:00 PM
FEBRUARY	11:55 AM	4:50 PM
MARCH	9:20 AM	9:20 AM
APRIL	H	H
MAY	H	H
JUNE	H	H
JULY	H	H
AUGUST	H	H
SEPTEMBER	H	H
OCTOBER	H	H
NOVEMBER	9:50 AM	7:10 PM
DECEMBER	H	H

STEP 1: TO CALCULATE AMT (MEAN ANNUAL AIR TEMP)
 = Highest mean daily max. air temp. of the year + Lowest mean daily min. air temp. of the year

$$\frac{2}{2}$$

 = 21.55

STEP 2: TO CALCULATE THE POSITION OF CENTRE OF COMFORT ZONE: (T_{cc})
 a. If AMT < 10°C Then T_{cc} = 20°C ET.
 b. If AMT > 10°C then T_{cc} = $\frac{AMT}{4} + 17.2$

$$\therefore T_{cc} = 22.58$$

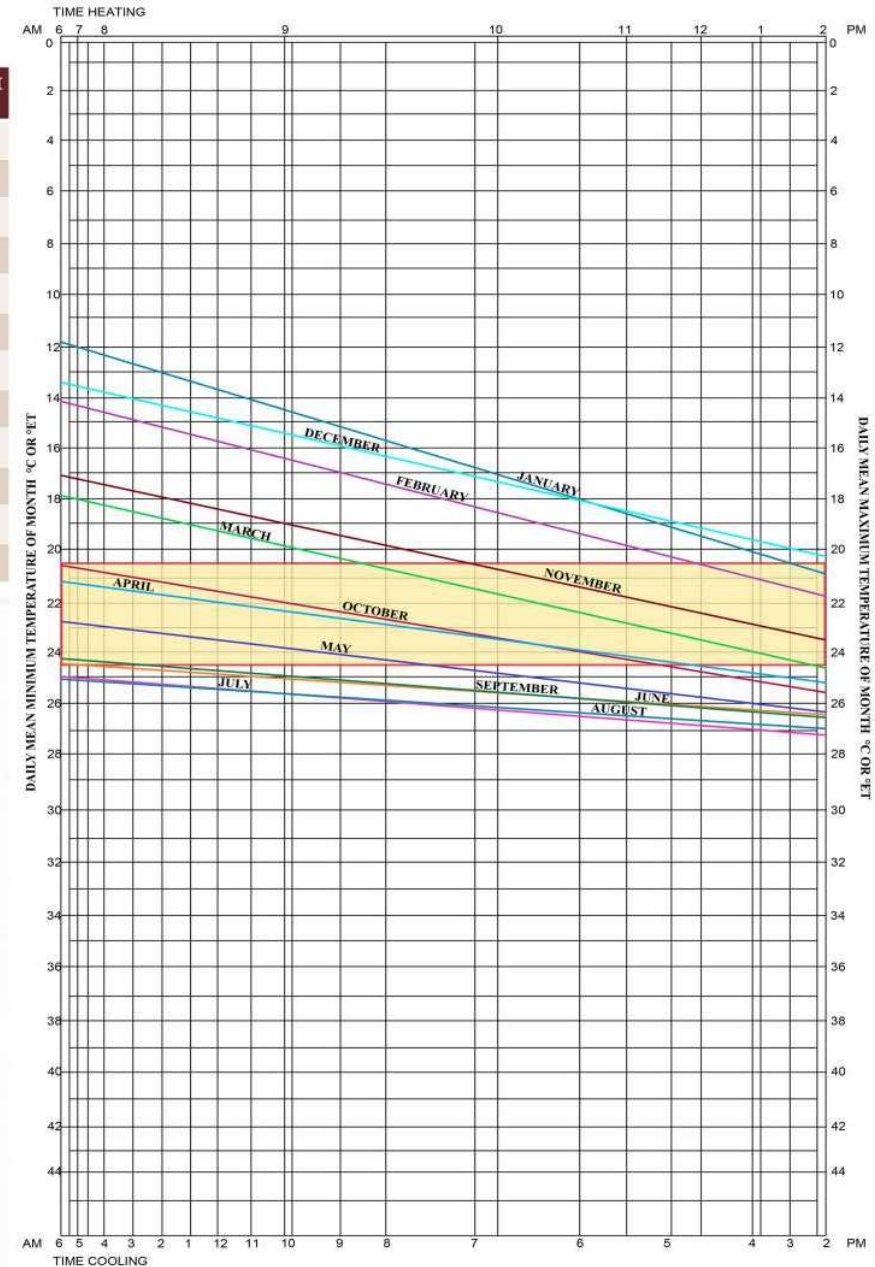
STEP 3: TO CALCULATE MEAN ANNUAL AIR TEMP. RANGE (AMR)
 = Highest mean daily max. air temp. of the year - Lowest mean daily min. air temp. of the year.
 = 18.5

STEP 4: TO CALCULATE THE WIDTH OF THE COMFORT ZONE W.R.T. THE FOLLOWING TABLE.

COMFORT ZONE SUPERIMPOSED ON ET CHART

MONTHS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Effective Temperature (°C)	15	15	15	15	15	15	15	15	15	15	15	15

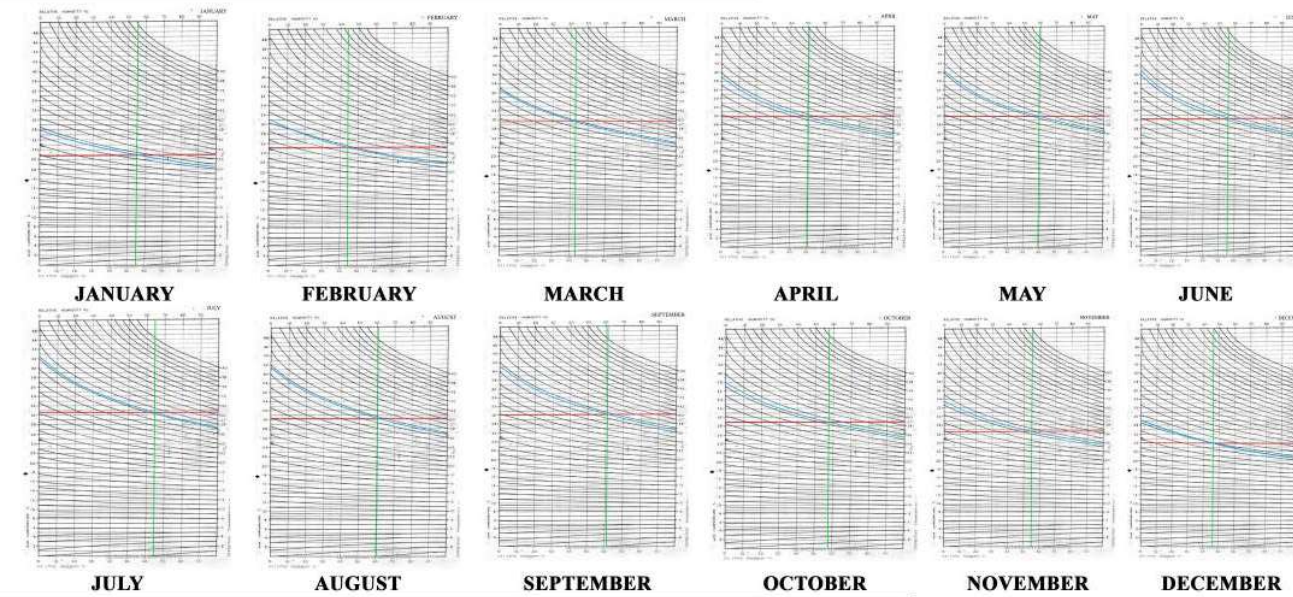
AMR (°C)	COMFORT ZONE RANGE (°ET)
Below 15	2.0
16-18	3.5
19-23	4.0
24-27	4.5
28-32	5.0
33-37	5.5
38-44	6.0
45-51	6.5
Above 51	7.0



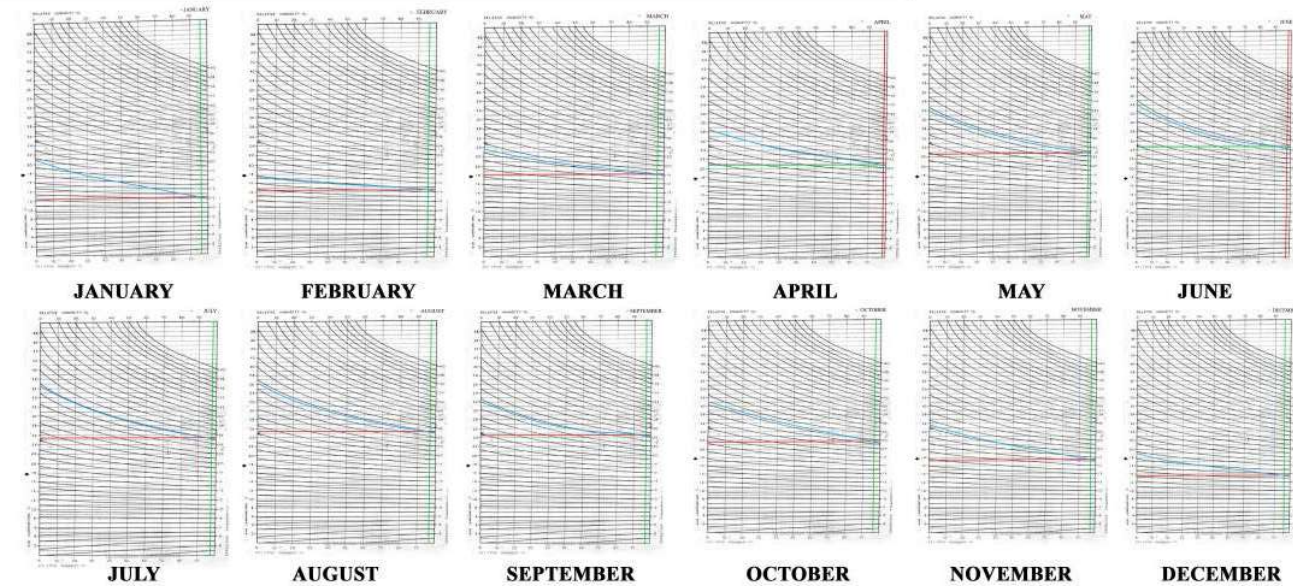
The heating starts from 1:30 pm in the month of January followed by 11:55am in February then 9:20am in march and 9:50am in November. The critical month starts from the month of April and in the month of December the temperature rises above the comfort band so it is also considered as the critical month.



MAXIMUM EFFECTIVE TEMPERATURE GRAPHS



CLIMATE DATA



OVER HEATED PERIOD AND SHADOW MASK

West facing window, VSA = 63 degree.
 West facing window, HSA = 76 degree.
 South facing window, VSA = 72 degree
 East facing window, VSA = 72 degree

